

# Operating-Room Procedures Do Not Increase Risk of COVID-19 Infection

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## ABSTRACT

**Background and Objectives:** Operating-room procedures canceled due to the COVID-19 pandemic depleted hospital revenue and potentially worsened patient outcomes through disease progression. Despite safeguards to resume elective procedures, patients remain apprehensive of contracting COVID-19 during hospitalization and recovery. We investigated symptomatic COVID-19 infection in patients undergoing operating-room procedures during the spring 2020 outbreak in Fairfield County, CT, a heavily affected New York Metropolitan area.

**Methods:** We retrospectively analyzed 419 operating-room patients in Danbury and Norwalk Hospitals between 3/16/20 and 5/19/20. COVID-19 infection was assessed through test results or documented well-being within 2 weeks postdischarge. Variables studied were procedure classification, length of stay, and discharge disposition. Postprocedural COVID-19 infection was analyzed using binomial tests comparing rates to state-mandated infection data.

**Results:** Six patients developed COVID-19 after 212 urgent-elective and 207 emergent procedures. Overall postprocedural infection risk was equivalent to community infection risk ( $P > .05$ ). No infections occurred in 1–2 day stays or urgent-elective procedures with discharge home (both  $P < .05$ ). Discharges home reduced the risk to one-sixth of community spread ( $P = .03$ ). Risk of

infection doubled in hospitalizations  $> 5$  days ( $P = .05$ ) and quadrupled in discharges to extended care facilities ( $P = .01$ ).

**Discussion:** Operating-room procedures did not increase the risk of symptomatic COVID-19 infection during an outbreak. Urgent-elective and emergent procedures during further outbreaks appear safe when anticipating short stays with discharges home. When anticipating prolonged hospitalization or discharges to facilities, appropriate delay of urgent-elective procedures may minimize risk of infection.

**Key Words:** COVID-19, Operating rooms, Elective surgical procedures.

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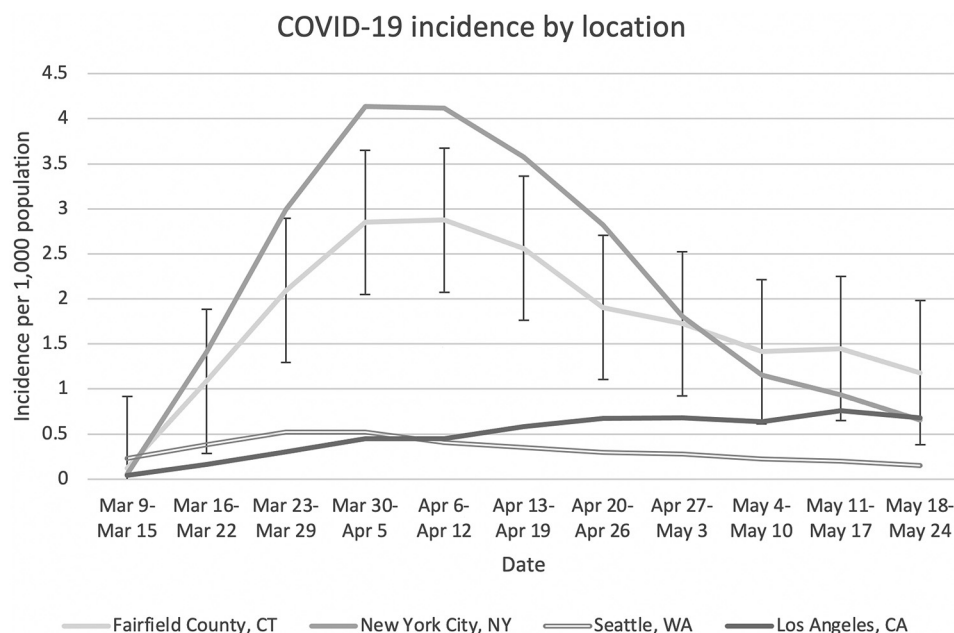
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## INTRODUCTION

The COVID-19 pandemic resulted in surgical delays for patients throughout the United States as hospitals around the country canceled non-urgent procedures. These cancellations potentially resulted in worsened patient outcomes through disease progression and complications, as well as significant losses in hospital revenue. Many hospitals are in dire financial situations from the pandemic, which could result in a loss of health services to the community.

Fairfield County of Connecticut is a component of the New York Metropolitan area.<sup>1</sup> Consequently, it was heavily affected by COVID-19 in the spring of 2020 (**Figure 1**, **Figure 2**). State-mandated data demonstrated a cumulative incidence of 18 in 1,000 population acquiring COVID-19 in the community during that time.<sup>2,3</sup> At times this was on par with incidence in New York City and was higher than most communities within the United States<sup>2–8</sup> (**Figure 1**).

Danbury and Norwalk Hospitals were high-volume COVID-19 centers serving Fairfield County of Connecticut. Multiple initiatives were launched to reduce COVID-19 transmission at the hospital and within the community. On March 16, 2020, all purely elective procedures



**Figure 1.** COVID-19 incidence by location. Incidence = (total positive tests/county population)  $\times$  1,000. Confidence interval =  $\pm 0.8$ . Fairfield County, CT, population 943,823.<sup>2,3</sup> New York City, NY, population 8,398,748.<sup>4,5</sup> Seattle, WA, population 2,226,300.<sup>6,7</sup> Los Angeles, CA, population 9,645,050.<sup>8</sup>

were canceled, visitors were restricted, and all staff were required to comply with state-mandated mask wearing, social distancing, and daily screening for COVID-19 symptoms, exposure, and fever.<sup>10-12</sup> By May 20, 2020 there was a sustained reduction in local COVID-19 incidence, and there were sufficient resources to address community COVID-19 hospitalizations and resume near-normal operating room function. As such, the operative suites reopened to all purely elective procedures.

Although the operating suites have resumed elective surgery, some patients remain hesitant to undergo procedures. When patients delay or avoid surgery for fear of contracting the virus, this may worsen pathology and surgical outcomes through disease progression. Instead of elective procedures, patients may require emergent surgery or more extensive procedures resulting in longer inpatient or rehabilitation stays to recover. With hospitals losing between \$6,000 and \$8,000 per COVID-19 admission, elective procedures are integral to their economic viability.<sup>13</sup>

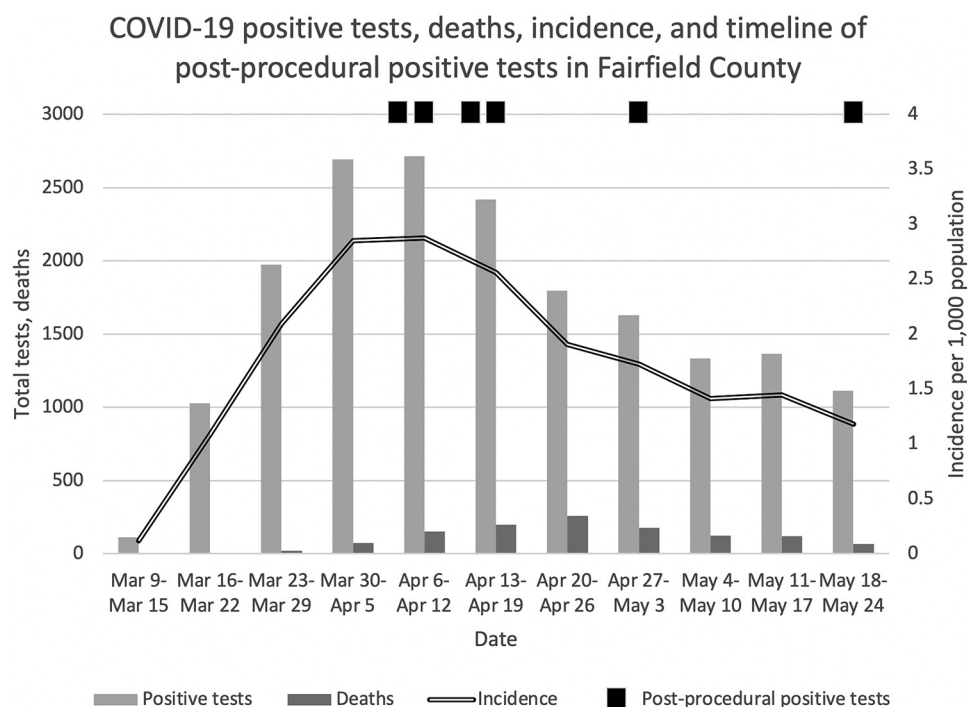
This study aims to explore the chance of acquiring COVID-19 after hospital procedures and whether case urgency, patient length of stay, or discharge disposition affect risk of infection. We aim to provide hospital

administration, proceduralists, and patients valuable information regarding risk of undergoing operating-room procedures during a COVID-19 outbreak.

## METHODOLOGY

In this retrospective cohort study, we identified patients who underwent operating-room procedures from March 16, 2020 through May 19, 2020 from the schedules of the Danbury Hospital and Norwalk Hospital operative suites. These dates encompass the peak COVID-19 period during which purely elective procedures were canceled and visitors were restricted. We analyzed all cases performed for persons 18 years or older that had documentation within the electronic medical record (EMR) of COVID-19 test status or symptoms within two weeks of discharge after procedures. Patients undergoing multiple procedures were included, but only the first operating-room procedure with adequate documentation was analyzed. Patients diagnosed with COVID-19 before procedures were excluded.

The primary outcome was a new diagnosis of COVID-19 postprocedurally within two weeks of discharge. The primary marker of this outcome was a COVID-19 test result. When COVID-19 tests were not performed



**Figure 2.** COVID-19 positive tests, deaths, incidence, and timeline of postprocedural positive tests in Fairfield County. Incidence = (total positive tests/county population of 943,823)  $\times$  1,000.<sup>2,3,9</sup>

during this period, medical provider documentation of absence of COVID-19 symptoms was used as a surrogate.

Variables studied included the classification of procedure, patient length of stay, and disposition. Urgent-elective procedures were those for which patients presented through outpatient assessment, whereas hospital assessment for surgery was considered emergent. Length of stay (LOS) was tracked as days present in the hospital, with ambulatory and overnight stays considered short, 3 to 5 days considered medium, and greater than 5 days considered long. We further categorized medium to long stays as inpatient. Disposition categories were discharge to home, home with services, and extended care facilities (ECFs). Home services involved visiting nurses, home health aides, and physical, occupational, and speech therapists. ECFs included short-term rehabilitation facilities through long-term nursing facilities.

COVID-19 infection risk was analyzed using two-sided binomial tests and the cumulative incidence of 18 in 1,000 population in Fairfield County, CT, from March 16, 2020 through May 19, 2020. This was derived from the State of Connecticut's open data

tracking COVID-19 infection across its counties and utilized the State's formula for incidence, which is the number of positive test results in Fairfield County divided by the Fairfield County population of 943,823 people, multiplied by 1,000.<sup>2,3</sup> Infection rate per 1,000 population was calculated in the patients we could track over the aforementioned time frame. Procedure classification was evaluated with reference to LOS and disposition, whereas disposition was also assessed with reference to LOS. All calculations and analyses were performed with the use of Microsoft Excel for Mac Version 16.41.

We sought to include as many adult patients without COVID-19 as could be tracked given the limitation of nonhospital-employed proceduralists utilizing external EMR systems. An ideal sample size for each subcategory was calculated to be at a minimum 155 patients to detect a significant infection rate with power of 0.8, confidence interval of 10 to 26 in 1,000, and effect size of 0.2.

The Biomedical Research Alliance of New York Institutional Review Board provided approval for the study (IRB # 20-12-275-337(c20)). All authors vouch for the completeness and accuracy of the data and the analyses.

**Table 1.**  
COVID-19 Infection and Incidence Based on Patient Procedure Classification vs. Length of Stay and Disposition

	Urgent Elective		Emergent		Total	
	Infection COVID+ / Total <sup>a</sup>	Infection rate <sup>b</sup> ( <i>P</i> value) <sup>c</sup>	Infection COVID+ / Total <sup>a</sup>	Infection rate <sup>b</sup> ( <i>P</i> value) <sup>c</sup>	Infection COVID+ / Total <sup>a</sup>	Infection rate <sup>b</sup> ( <i>P</i> value) <sup>c</sup>
Length of stay						
Short (1–2 days)	0/163	0/1,000 (0.05)	0/45	0/1,000 (0.44)	0/208	<b>0/1,000 (0.02)</b>
Medium (3–5 days)	0/33	0/1,000 (0.55)	1/54	19/1,000 (0.37)	1/87	11/1,000 (0.33)
Long (6+ days)	2/16	<b>125/1,000 (0.03)</b>	3/108	28/1,000 (0.18)	5/124	<b>40/1,000 (0.05)</b>
Disposition						
Home	0/182	<b>0/1,000 (0.04)</b>	1/111	9/1,000 (0.27)	1/293	<b>3/1,000 (0.03)</b>
Home with services	0/27	0/1,000 (0.61)	2/69	29/1,000 (0.23)	2/96	21/1,000 (0.27)
Extended care facilities	2/3	<b>667/1,000 (0.001)</b>	1/27	37/1,000 (0.30)	3/30	<b>100/1,000 (0.01)</b>
Total	2/212	9/1,000 (0.16)	4/207	19/1,000 (0.20)	6/419	14/1,000 (0.14)

<sup>a</sup>COVID+ / Total = (number of patients with postprocedural COVID-19 infection) / (category population).

<sup>b</sup>Infection rate = (COVID+ / Total) per 1,000.

<sup>c</sup>*P* value calculated by two-sided binomial using 18/1,000 as community incidence.

## RESULTS

Of 1003 cases on the operative schedules, 17 were pediatric patients, 25 were patients with COVID-19, and 114 were multiple procedures for a patient. 428 patients did not have postprocedural COVID-19 status available for analysis. Of the 419 patients who had documentation of a COVID-19 status within 14 days of discharge, 212 underwent urgent-elective procedures, 207 underwent emergent procedures, and 6 developed COVID-19 (**Figure 2**).

Overall, postprocedural COVID-19 infection risk was equivalent to community infection risk ( $P > .05$ ). Subset analyses show statistical significance in the following categories. There was no infection among short stay ( $P = .02$ ) or urgent-elective patients discharged home ( $P = .04$ ). There was reduced risk of COVID-19 infection to one-sixth of community infection risk for all patients discharged home ( $P = .03$ ). Risk of infection doubled in all long hospitalizations ( $P = .05$ ). This risk quadrupled for all discharges to ECFs ( $P = .01$ ) (**Table 1**, **Table 2**).

The 6 patients contracting COVID-19 were all inpatients who otherwise had varied characteristics. There was no significant preponderance of procedure classification, procedure type, hospital, disposition, or COVID-19 outcome. Two-thirds of patients contracting postprocedural COVID-19 required rehospitalization. All-cause mortality

when acquiring COVID-19 postprocedurally was 33% of patients. (**Table 3**).

## DISCUSSION

We examined data on all patients who could be tracked through the Danbury Hospital and Norwalk Hospital operative suites to determine how frequently postprocedure patients acquire COVID-19. During the time when purely elective procedures were canceled, we identified 6 patients who became infected with COVID-19. Overall postprocedural COVID-19 infection risk was equivalent to community infection risk in Fairfield County. Our results suggest that hospital operating-room procedures do not pose increased risk of symptomatic COVID-19 infection in general during an outbreak.

Operating-room procedures appear to have lower risk than community contact when patients undergo ambulatory and overnight stays following operating-room procedures and when patients were able to discharge home without services. This may be due to patients maintaining social-distancing practices while recuperating at home. They may also be hypervigilant due to perceived increased risk having been admitted to a hospital treating numerous patients with COVID-19. Regardless, it is reassuring that both patients presenting to the operative suite

**Table 2.**

COVID-19 Infection and Incidence Based on Length of Stay versus Disposition

	Short (1-2 Days)		Medium (3-5 Days)		Long (6+ Days)		Total
	Infection COVID+ / Total <sup>a</sup>	Infection rate <sup>b</sup> (P value) <sup>c</sup>	Infection COVID+ / Total <sup>a</sup>	Infection rate <sup>b</sup> (P value) <sup>c</sup>	Infection COVID+ / Total <sup>a</sup>	Infection rate <sup>b</sup> (P value) <sup>c</sup>	Infection COVID+ / Total <sup>a</sup>
Home	0/199	<b>0/1,000 (0.03)</b>	1/59	17/1,000 (0.37)	0/35	0/1,000 (0.53)	1/293
Home with services	0/9	0/1,000 (0.85)	0/25	0/1,000 (0.64)	2/62	32/1,000 (0.21)	2/96
Extended care facilities	0/0	0/1,000 (1)	0/3	0/1,000 (0.95)	<b>3/27</b>	<b>111/1,000 (0.01)</b>	<b>3/30</b>
Total	0/208	<b>0/1,000 (0.02)</b>	1/87	11/1,000 (0.33)	<b>5/124</b>	<b>40/1,000 (0.05)</b>	6/419
							14/1000 (0.14)

<sup>a</sup>COVID+ / Total = (number of patients with postprocedural COVID-19 infection)/(category population).

<sup>b</sup>Infection rate = (COVID+ / Total) per 1,000.

<sup>c</sup>P value calculated by two-sided binomial using 18/1,000 as community incidence.

from home and through the hospital did not contract COVID-19 if able to discharge home by the following day. Short-stay procedures and procedures with discharges home without services appear safe to perform during an outbreak of COVID-19. These findings are supported by sufficient power.

COVID-19 infection risk in urgent-elective procedures was less than that of emergent procedures and community spread, however, both procedural classifications were not significantly different from community infection risk. Data from our two institutions is of sufficient power to validate these findings. Overall medium LOS and discharge home with services did not have significantly increased risk of acquiring COVID-19 compared to community contact.

Long hospitalizations and discharges to ECFs increased the risk of acquiring COVID-19. This is consistent with the high rate of interaction between staff and patients in such settings, over an extended duration, increasing the risk of patient exposure to infection. The predominance of urgent-elective patients with short stays and who discharged home increased the significance of COVID-19 infection in the two urgent-elective patients with long hospitalizations and who discharged to ECFs. This weighted the overall significance of long hospitalizations and discharges to ECFs as being riskier for COVID-19 infection than in the community at large. Our findings may also be indicative of ECFs lacking infrastructure to safely distance patients at that time. Now being 14 months into the pandemic, ECFs may have appropriate safeguards in place to contain COVID-19 transmission, however, it may be prudent to prolong LOS if that enables a patient to discharge home with services.

Our study has several important limitations. As a retrospective analysis limited to the two hospitals' shared EMR system, approximately 50% of postprocedural patients were excluded in our convenience sampling approach. We were unable to obtain research department permission to contact patients from nonhospital employed surgeons who do not use the hospitals' EMR for postprocedural assessment. New diagnoses of COVID-19 were likely missed in asymptomatic patients, those with COVID-19 tests performed at outside hospitals, and those who may have died before hospital presentation from undiagnosed COVID-19. Our study was powered for community incidence within the confidence interval of 10 to 26 in 1,000 population over 65 days, and so is not applicable to communities with greater incidence. Repeating this study with a larger population, with standardized postprocedural COVID-19 testing, and at multiple



**Table 3.**  
Characteristics of Patients Contracting COVID-19

Procedure Date	Discharge Date	COVID+ Date	Age, Sex	Classification	Procedure Type	Hospital	LOS <sup>a</sup>	Disposition	COVID Outcome <sup>b</sup>
3/25	4/1	4/6	91, Female	Urgent Elective	Thoracic laminectomy with excision of large meningioma causing severe spinal cord compression	Danbury	8	Extended care facility	Admit to floor (LOS 11), died
3/25	3/31	4/9	65, Male	Emergent	Right below-knee amputation for severe right foot gangrene	Norwalk	14	Extended care facility	Admit to floor (LOS 13), recovered
4/11	4/13	4/13	45, Male	Emergent	Laparoscopic lysis of adhesions with appendectomy for small bowel obstruction	Norwalk	4	Home	Recovered at home
3/31	4/5	4/15	78, Female	Urgent Elective	Right reverse shoulder replacement for 100% displaced proximal humerus fracture	Danbury	6	Extended care facility	Admit to floor (LOS 3), recovered
4/4	4/13	4/27	75, Male	Emergent	Right hip open reduction internal fixation for proximal femur fracture	Danbury	11	Home Care	Recovered at home
5/1	5/12	5/21	70, Male	Emergent	Transesophageal echocardiogram (TEE is typically performed in the OR in our hospital)	Danbury	20	Home Care	Admit to floor (LOS 4), Readmit required ICU (2 <sup>nd</sup> LOS 7), died

<sup>a</sup>LOS is length of stay for procedural hospitalization.

<sup>b</sup>COVID Outcome includes related admission, LOS of readmission, and recovery status.

institutions may clarify risk for longer hospitalizations and discharge to ECFs.

In summary, we retrospectively reviewed patients undergoing operating-room procedures within Fairfield County to determine the risk of contracting symptomatic COVID-19 postprocedurally during an outbreak. For community infection rates up to 18 in 1,000 population as in this study, overall operating-room procedures did not pose an increased risk of COVID-19 infection and actually lowered the risk of infection in the setting of ambulatory and overnight procedures and discharges home without services. In the event of further outbreaks where community COVID-19 hospitalization needs are sufficiently managed, it appears safe to continue urgent-elective and by logical extension elective procedures if short to medium-term hospitalization with discharge home with or without services is anticipated. When prolonged hospitalizations or discharge to ECFs are anticipated with urgent-elective or elective procedures, it may be prudent to delay procedures appropriately to minimize risk of infection. Patients undergoing emergent procedures overall appear to have

similar rates of acquiring COVID-19 compared to the general population in Fairfield County. As such, the authors recommend continuing to operate on emergency patients as per standard of care.

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